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Central and Arctic Region
Canadian Science Advisory Secretariat
Science Advisory Report 2014/025

ASSESSMENT OF FRESHWATER ECOLOGICALLY AND BIOLOGICALLY SIGNIFICANT AREAS (EBSA) AND ECOLOGICALLY SIGNIFICANT SPECIES (ESS) CRITERIA

Figure 1. Map of Bay of Quinte, Lake Ontario.

Context

In marine areas, ecologically sensitive habitats and fish species that require enhanced management were identified under the Oceans Action Plan using specific criteria that address four conservation priorities:

1) *Ecologically and Biologically Significant Areas (EBSA);*
2) *Ecologically Significant Species (ESS);*
3) *depleted or rare species; and,*
4) *degraded areas.*

These criteria can potentially be used for identifying significant areas and species in freshwater ecosystems as well.

Fisheries and Oceans Canada (DFO) Science has been asked to determine the feasibility of transferring knowledge between marine and freshwater ecosystems, by extrapolating and assessing the criteria for identifying significant habitat and species in marine ecosystems to freshwater ecosystems. The Bay of Quinte, Lake Ontario, was chosen as a freshwater case study. Criteria were evaluated by identifying key biota and important habitat in the Bay of Quinte, Lake Ontario using the EBSA and ESS criteria.

The identification and efficacy of ecologically significant areas in freshwaters as a tool for managers was included in the amendments to the Fisheries Act. *This review of criteria was requested as a proactive task to initiate the evaluation of the existing criteria for potential use in freshwater ecosystems, using the Great Lakes as a pilot.*

November 2014

Canada

This Science Advisory Report is from the November 19-20, 2013 Freshwater Ecologically and Biologically Significant Areas (EBSA) / Ecologically Significant Species (ESS) Criteria Assessment meeting. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada Science Advisory Schedule *as they become available.*

SUMMARY

Identification and designation of Ecologically and Biologically Significant Areas (EBSA) and Ecologically Significant Species (ESS) is recognized both nationally and internationally as a potentially useful tool for aquatic resource conservation, management and planning.

- The establishment of EBSAs under Canada's *Ocean's Act* is well-established in marine areas of Canada, and has been highlighted as a potential tool for the Fisheries Protection Program when implementing the 2012 amendments to the *Fisheries Act*.
- For identifying potential EBSAs in marine ecosystems, three primary criteria (uniqueness, aggregation and fitness consequences) and two qualifiers (resilience and naturalness), are judged in the context of ecological functions and structural features. For identifying ESS, four species or community properties (trophodynamics, 3-dimensional structure, threats, and sensitivity) are used.
- The objectives of this review were to assess feasibility for applying these criteria in a freshwater context (using the Bay of Quinte as a case study), document lessons learned from the application of the criteria, summarize knowledge gaps, assess feasibility of applying the criteria in other freshwater systems, and list key conclusions and advice for applying EBSA/ESS criteria in freshwater systems.
- It was concluded that both the EBSA and ESS criteria could be feasibly applied to the Great Lakes and other large lake systems in Canada; however, application would be challenging in data-poor systems. To identify EBSAs, general ecological or experiential knowledge could provide the basis for applying the criteria in freshwater, but site-specific data would be required to validate criteria and determine boundaries. When determining ESSs, additional sampling may be needed to characterize community composition, detect rare species, and describe the geographic distribution of species.
- Central knowledge gaps included the applicability of criteria to data-poor areas (e.g., northern Canada), and the ability to determine the best spatial scale for application of the criteria.
- Specific knowledge gaps and concerns included a lack of quantitative information linking habitat features to vital rates (to inform the 'fitness consequence' criteria), and a need for a greater understanding of trophic interactions as well as relative abundance estimates (to inform the ESS criteria). Further consideration should be given to the limitations of relying on expert opinion to inform the criteria.
- Overall, it was determined that the Oceans Action Plan definition of ecological 'significance' applies equally to freshwater ecosystems and species, and the EBSA and ESS criteria can be applied and measured in freshwater ecosystems. However, the use of EBSA and ESS in freshwater is scale dependent. Determining the appropriate spatial scale for significant areas requires further research.
- EBSA and ESS criteria developed for marine areas under the *Oceans Act* provide a scientifically defensible starting point for determining Ecologically Significant Areas identified in the 2012 amendments to the *Fisheries Act*.

BACKGROUND

The identification and designation of ecologically significant areas, broadly defined as areas with relatively high productivity or biodiversity, is a useful tool for ecosystem-based resource management. Ecologically significant areas provide a spatial focus for the enhanced management of human activities, which can benefit the aquatic biota and their habitat. Canada's *Oceans Act* (1997) authorized DFO to lead the development of a national oceans management strategy. Five Large Ocean Management Areas (LOMA) were identified: Pacific North Coast, Beaufort Sea, Eastern Scotian Shelf, Gulf of St. Lawrence and Placentia Bay/Grand Banks. Within each LOMA, four issues were investigated as candidate conservation priorities to be addressed:

1. Ecologically and Biologically Significant Areas (EBSA);
2. Ecologically Significant Species (ESS);
3. depleted or rare species; and,
4. degraded areas.

These conservation issues included both location-based (EBSAs and degraded areas) and species-based (ESS and rare species) valued ecosystem components. Criteria for each of the conservation priorities for identifying significant marine areas and species were developed and applied in marine areas of Canada.

For marine EBSAs and ESS, 'significant' was interpreted as 'if the area or species were perturbed severely, the ecological consequences (in space, in time, or outward through the food-web) would be greater than an equal perturbation of most other areas or species' (DFO 2006). Therefore, the identification of significant areas or species is based on ecological criteria rather than on social, economic or jurisdictional factors (DFO 2004).

The Ocean's EBSA and ESS criteria were developed for marine ecosystems, but many of the concepts and criteria may apply to freshwater ecosystems. To investigate this feasibility, the EBSA/ESS criteria were assessed in the Bay of Quinte, Lake Ontario. Also relevant was that ecologically significant areas were identified as a potential tool in the 2012 amendments to the *Fisheries Act*, but interpretation in freshwaters has yet to be complete.

The objectives of this science review were to:

1. assess whether or not the EBSA and ESS criteria applied to freshwaters, using the Bay of Quinte as a spatial context;
2. document lessons learned from applying the EBSA and ESS in a freshwater system;
3. summarize knowledge gaps;
4. assess feasibility of applying the criteria in other freshwater systems; and,
5. list key conclusions and advice for applying EBSA/ESS criteria in freshwaters.

This report focuses on the discussion and summary of conclusions from a Canadian Science Advisory Secretariat (CSAS) peer-review meeting that occurred on November 19-20, 2013 in Burlington, Ontario. A research document, applying the EBSA criteria to a freshwater ecosystem (Randall et al. 2014), and a second research document, applying the ESS criteria (Glass et al. 2014) provide in-depth accounts of the information summarized below. Proceedings that document the discussions and key conclusions of the meeting are also available (DFO 2014).

ASSESSMENT

Methods

Ecologically and Biologically Significant Areas

EBSA criteria were interpreted and assessed in three steps:

1. obtaining definitions and examples of the criteria from marine ecosystems, particularly coastal areas if available;
2. assessing if the marine criteria were relevant, measureable with quantitative metrics and able to be extrapolated for use in the Lake Ontario ecosystem; and,
3. assessing if any physical habitat features considered to be significant in Lake Ontario were absent from the marine criteria.

For step 1, the EBSA criteria and marine examples were obtained from CSAS published research documents, proceedings and science advisory reports. Narrative descriptions of three primary criteria, uniqueness, aggregation and fitness consequences, were included, along with definitions and descriptions of two additional qualifiers, resilience and naturalness. The three criteria and two qualifiers were described in the context of ecological functions (e.g., spawning, nursery, feeding, migration, refugia) and structural features (e.g., oceanographic, structural habitat, biodiversity).

For step 2, relevance of the criteria to the Great Lakes and feasibility of their extrapolation were assessed by identifying Lake Ontario examples of significant ecological function and metrics for each criterion. The Bay of Quinte (Lake Ontario), was chosen as a pilot area for assessing the EBSA criteria because this coastal region has received enhanced management for a numbers of years. Although eutrophication and other environmental concerns have negatively affected this ecosystem, it is known to have high productivity and biodiversity relative to other areas in Lake Ontario. The EBSA criteria were assessed by comparing quantitative metrics in the Bay of Quinte with other coastal areas in Lake Ontario. Details of the function and structure of significant habitats were based on scientific evidence, either specific literature citations or from expert opinion. The ecological functions in step 2 pertain to the habitat areas needed to complete key life history processes (e.g., spawning, nursery, rearing, feeding, migration).

Finally, for step 3, the identification of gaps in the criteria from a Lake Ontario perspective and lessons learned were based on the literature and the expert opinion of Great Lakes scientists.

Ecologically Significant Species

A species list was compiled from published data sources and DFO sampling records. Species were assessed by a group of scientists familiar with the taxa in question and the Bay of Quinte. Significance was assigned to individual species based on expert opinion and application of the ESS criteria. From this assessment, a list of ecologically significant species was created. Each trophic level was evaluated for species of potential significance, beginning with primary producers (both phytoplankton and aquatic vegetation), up to and including large predatory fishes.

Strengths and weaknesses

Ecologically and Biologically Significant Areas

Certain limitations and qualifications apply to the EBSA criteria assessment. The Bay of Quinte was selected to assess the EBSA criteria because of the availability of long-term (> 30 years)

datasets for all trophic levels and environmental conditions. However, the fact that the Bay of Quinte was a degraded area undergoing remediation sometimes confounded the interpretation of the EBSA criteria. Nevertheless, the extrapolation and application of the criteria would be more challenging in freshwater areas where fewer data are available, particularly in northern areas. Also, assessment of the criteria must still be done for fluvial freshwater fish habitat.

The spatial scale of the approach used in this study, that is, the Bay of Quinte versus the whole of Lake Ontario, was informative for evaluating the EBSA criteria. On the one hand, the significance of ecological functions and structural habitat features in the Bay of Quinte could be effectively judged by comparison to other areas in Lake Ontario. However, the spatial scale of the EBSA for this case study was predetermined by our approach (all of Bay of Quinte). EBSAs in marine areas are often larger than the Bay of Quinte. However, during criteria assessment, it was apparent that some key ecological functions and structural features sometimes applied to more localized (smaller) habitat areas. The conservation objectives would also be relevant for identifying the appropriate scale; for example, conserving habitat for species-at-risk would likely focus on a smaller spatial scale (e.g., critical habitat) than conserving habitat for fisheries (populations). This study was not designed to assess and determine the appropriate spatial scale of EBSAs. Other approaches for identifying potential EBSAs such as data-layering may be more useful for detecting the spatial boundaries and extent of ecologically significant areas.

Ecologically Significant Species

The application of the ESS criteria, previously used solely in marine systems, successfully identified species as significant in the Bay of Quinte ecosystem. Management of these ecologically significant species will be important to maintain the structure and function of the Bay of Quinte ecosystem.

Reliance on expert opinion is a potential weakness of the implementation of ESS criteria. In the case of the Bay of Quinte, which is a highly studied ecosystem, the aquatic community is well known and there are a sufficient number of experts to make informed designations of ESS. In less intensely studied systems this may prove problematic.

Another shortcoming of the application of ESS criteria is the tendency to focus on commercially valuable and charismatic species (DFO 2012). When designating ESS, it is important to separate the ecological significance from the economic or cultural significance.

When considering lower trophic levels and the community-level properties, it was found that the significant species varied between years and among seasons. This made it difficult to designate any single species as significant in the lower trophic levels. The use of area-based techniques (EBSAs) may better account for these properties. Additionally, considering a group of species collectively, as we have treated submerged aquatic vegetation and Kenchington et al. (2011) have treated corals and sponges, may prove useful in capturing community-level processes.

Lessons learned from applying assessment to a freshwater system

Ecologically and Biologically Significant Areas

Assessment of each EBSA criteria revealed a few 'lessons learned' to consider for future applications relevant to ecological function in freshwater. The influence and importance of riparian areas to freshwater aquatic habitat could be added as an ecological function affecting fitness. Also, the extent of the land-water interface (transition zone) and degree of exposure (fetch) are important physical properties in freshwater lakes. Freshwater habitat diversity is important, as there is a strong correlation between habitat diversity and fish species diversity in

freshwater regions. Thermal habitat as a factor affecting regional patterns in productivity, and resilience to fluctuations in climate are important in freshwater ecosystems.

Identification of significant areas of high biodiversity (fishes and other biota) is a priority in the Great Lakes and elsewhere in freshwaters. Although biodiversity is clearly recognized in the marine EBSA criteria, latitudinal and regional variation in biodiversity is a primary driver and a focus for managers in freshwater ecosystems. Also, connectivity of habitat is a key factor in freshwaters.

Rare or low abundance species in freshwater often face habitat-related threats, rather than the fishing-related threats that confront marine species. The identification and conservation of essential habitat for all life stages, even for small spatial scales, is important for freshwater species.

Ecologically Significant Species

The criteria for identifying ESS were readily interpretable and applicable in the freshwater context, using the Bay of Quinte as an example ecosystem. In the case of the Bay of Quinte, a single waterbody was used to designate ESS. When considering inland systems, employing a broader scale than individual lakes, such as the watershed or regional scale, may be necessary due to the vast number of inland waterbodies and the lack of information on many of the lesser-studied systems.

Lower trophic levels and community properties do not lend themselves well to designation based on ESS criteria due to the lack of data and shifting abundances among species over time. Area based criteria may be more useful in defining significance at the lower trophic levels.

Sources of uncertainty

Ecologically and Biologically Significant Areas

Determining the appropriate spatial scale for applying the ecological criteria of significant areas is a current source of uncertainty in freshwater ecosystems. Application of the criteria in areas where habitat data are lacking (e.g., Canada's north) would also be a significant source of uncertainty.

Ecologically Significant Species

The reliance on expert opinion for the designation of ESS is a source of uncertainty. In the case of the Bay of Quinte, published information was available to supplement designation of some of the species. However, much of the information on particular species is often general and derived from studies conducted elsewhere, creating a need to rely on expert opinion. The extrapolation from data-rich systems to data-poor systems is another potential uncertainty in the application of the criteria to identify ESS.

CONCLUSIONS AND ADVICE

The ecological criteria for identifying EBSA and ESS in marine areas of Canada are transferable to the Bay of Quinte, Lake Ontario and likely to other freshwater ecosystems. All criteria were interpretable and measurable in Lake Ontario.

Lessons learned from applying the criteria in Lake Ontario: riparian areas, extent of land-water interface, exposure, habitat diversity and regional patterns in productivity (thermal) and biodiversity are important as ecological factors affecting population fitness. Connectivity of freshwater habitats is paramount. The appropriate spatial scale for significant areas is difficult to

define, but will range from smaller areas of essential habitat to broader areas such as watersheds or regions. Defining significance for species at lower trophic levels may be best accomplished using area-based criteria.

Current challenges that should be addressed include:

- determination of the appropriate spatial scale for applying the ecological criteria of significant areas (e.g., using GIS-based data-layering);
- science assessment of the criteria for fluvial habitat, northern areas and areas where data are limited;
- research on regional patterns in productivity, thermal conditions, and projected future change;
- advancement of spatial models that link habitat to fish populations to better understand area-dependent growth and survival (fitness); and,
- reliance on expert opinion or data extrapolation needs to be reduced or validated.

To advance the use of ecologically and biologically significant areas as a management tool in freshwater ecosystems, the Ocean's EBSA/ESS ecological criteria are recommended as a useful starting point.

SOURCES OF INFORMATION

This Science Advisory Report is from the 19-20 November 2013, Freshwater Ecologically and Biologically Significant Areas (EBSA) / Ecologically Significant Species (ESS) Criteria Assessment meeting. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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THIS REPORT IS AVAILABLE FROM THE:

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ISSN 1919-5087
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Correct Citation for this Publication:

DFO. 2014. Assessment of freshwater Ecologically and Biologically Significant Areas (EBSA) and Ecologically Significant Species (ESS) criteria. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2014/025.

Aussi disponible en français :

MPO. 2014. Évaluation des critères relatifs aux zones d'importance écologique et biologique (ZIEB) et aux espèces d'importance écologique (EIE) en eau douce. Secr. can. de consult. sci. du MPO, Avis sci. 2014/025.